

Abstract No. kowa0008

Properties of an Ion-Etched Plane Laminar Holographic Gratings

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Beamline(s): X24C

Introduction: The near-normal incidence efficiency in all orders of a laminar grating should oscillate with wavelength because of constructive and destructive interference between radiation diffracted from the lands and the grooves.

Methods and Materials: Using the X24C reflectometer, we measured the near-normal incidence efficiency of a bare ion-etched plane laminar holographic grating made of fused silica with 1000 grooves/mm. The groove profile was characterized using measurements from an atomic force microscope (AFM).

Results: The measured grating efficiency peaked in the +1 order at values of 0.027%, 0.011%, and 0.005% at wavelengths of 191, 157, and 132 Angstroms, respectively. The derived groove efficiencies were 27%, 25%, and 27%. The measured groove depth determined from the AFM measurements was 434 Angstroms.

Conclusions: The average groove profile was used to model the grating efficiency, and the resulting wavelengths predicted for different order maxima and minima agree well with measured wavelengths, although the calculated efficiencies are greater than the measured results by 10-20%.

Acknowledgments: This research is supported at NRL by the Office of Naval Research under W.U. 3641: Application of Multilayer Coated Optics to Remote Sensing.

Reference: W. R. Hunter, M. P. Kowalski, J. C. Rife, and R. G. Cruddace, "Investigation of the properties of an ion-etched plane laminar holographic grating," *Applied Optics*, **40**, 6157-6165 (2001).